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Competition during the milk-feeding stage influences the development of feeding behavior of pair-housed dairy calves

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ABSTRACT

This study investigated how the feeding behavior of pair-housed calves develops in response to reduced teat and feed place availability. Twenty Holstein bull calves were pair housed and provided with milk replacer (MR) and grain concentrate ad libitum via either (1) 1 teat and feed bucket/pen, such that calves could not feed simultaneously [competitive feeding (CF)] or (2) 2 teats and feed buckets/pen [noncompetitive feeding (NCF)]. The calves were weaned during wk 7 of life by incrementally diluting the MR. Postweaning, all pens were managed identically and offered a complete pelleted diet ad libitum via 2 feed buckets/pen (NCF) in period 1 (wk 8 and 9) and period 3 (wk 12 and 13) and exposed to a competitive challenge with CF in period 2 (wk 10 and 11). Feeding times and competitive interactions were recorded from video for 3 d/wk in wk 2, 4, and 6 and 2 d/wk in wk 8 to 13. Meal criteria were used to calculate daily meal frequency, meal time, and synchronized meal time (the percentage of meal time when calves within the pen were engaged in simultaneous meals). Milk replacer intake was subject to a treatment × week interaction, with calves in CF pens having lower MR intake (wk 2: 8.3 vs. 10.0 L/calf per day for CF vs. NCF), but compensating by increasing intake to a greater extent over time (wk 4–5: 13.3 vs. 11.7 L/d for CF vs. NCF). Corresponding to MR intake, meal frequencies and feeding times evolved differently over this period, increasing in CF pens and decreasing in NCF pens (wk 2: 5.8 vs. 11.1 and wk 4–6: 6.2 vs. 5.1 meals/d for CF vs. NCF). Calves in CF pens also spent less time engaged in synchronized meals (28 vs. 51% of meal time; standard error = 7.1) and displaced each other 5 times more frequently during synchronized eating. Postweaning, calves in previously CF pens maintained 5 times greater displacement frequencies and had fewer overlapping meals than calves in previously NCF pens (34.5 vs. 40.7% of meals, respectively). Postweaning, when calves were all fed noncompetitively (2 buckets/pen in periods 1 and 3), calves previously fed CF had greater intakes in period 3 (4.87 vs. 4.44 kg/d) and a tendency for greater intake in period 1 (2.80 vs. 2.63 kg/d), greater rates of intake in period 3 (87.8 vs. 72.0 g/min) and a tendency for greater rates of intake in period 1 (44.3 vs. 38.9 g/min), and greater meal frequencies in both periods (11.1 vs. 9.9 meals/d). In the competitive challenge period (1 bucket/pen in period 2), intake, rates of intake, and meal frequencies were subject to treatment × week interactions: calves in NCF pens had lower intake and meal frequencies, but increased meal frequency, intake, and rate of intake over time to a greater extent than calves previously in CF pens. These results indicate that calves are able to adapt to moderate competition by increasing meal frequency and that behavioral responses to competition persist postweaning.

Key words: dairy calf, competition, feeding behavior, feed intake

INTRODUCTION

Evidence exists that social housing improves the growth and welfare of dairy calves, through reducing stress and supporting weight gain around weaning (Chua et al., 2002; De Paula Vieira et al., 2010), encouraging feed intake through socially facilitating feeding behavior (Phillips, 2004; De Paula Vieira et al., 2010), and supporting the development of normal social behavior (Veissier et al., 1994; Duve and Jensen, 2011). However, housing calves in groups poses challenges for feed access, and it is common for group-housed calves to experience competition for access to milk (Jensen, 2004; De Paula Vieira et al., 2010).

In response to competitive pressures while feeding, animals must make trade-offs between daily feed intake, feeding rates, and feeding synchrony (Nielsen, 1999). In heifers and adult cows, reducing available feeding stations or feed bunk space increases intake rates (Harb et al., 1985; Hosseinkhani et al., 2008; DeVries

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and von Keyserlingk, 2009; Proudfoot et al., 2009) and competitive interactions around feed (DeVries et al., 2004; Huzzey et al., 2006; Proudfoot et al., 2009), and decreases meal frequencies (Hosseinkhani et al., 2008; DeVries and von Keyserlingk, 2009). Cows also respond to competition for feed by spending more time feeding at night (Olofsson, 1999), suggesting that feeding synchrony is reduced. This flexibility of feeding behavior suggests that cattle in competitive environments prioritize maintaining intake, achieving this through adapting their feeding patterns and rates of intake. As further evidence, although intake may be negatively affected by competition in certain environments (Proudfoot et al., 2009), it appears to be less consistently affected than feeding rate or meal frequency (Hosseinkhani et al., 2008; DeVries and von Keyserlingk, 2009).

Similar behavioral responses to competition have also been observed in dairy calves, with intake rates and frequencies of competitive displacements at the milk feeder increasing with increasing group size and decreasing teat availability (Jensen, 2004; von Keyserlingk et al., 2004). Results reported by von Keyserlingk et al. (2004) also indicate that a short-term (1-d) reduction in the number of teats available to ad libitum-fed group-housed calves negatively affects milk intake. However, these results do not provide insight into how intake and feeding patterns are affected by level of competition over a longer time frame. Thus, it is unclear what mechanisms calves possess to adapt feeding patterns to sustain intake when faced with competition and reduced access to feeders over the course of the milk-feeding stage. Given the increasing prevalence of systems where calves are group housed and provided greater quantities of milk (e.g., computerized feeders for groups of 10 to 15 calves; Weber and Wechsler, 2001; Jensen and Holm, 2003), it is important to ascertain the ability of calves to adapt their feeding behavior and maintain intake when faced with competition at the feeder. Furthermore, little work to date has assessed whether behavior developed in response to levels of competition early in life may persist after weaning off milk. The early environment has been found to affect social behavior later in life; for example, evidence exists that, compared with calves housed individually, calves raised in groups have greater competitive success (Duve et al., 2012) and gain higher places in the herd rank order, as evaluated by competitive displacements later in life (Warnick et al., 1977; Broom and Leaver, 1978).

The overall objective of this study was to assess the effect of competition for feed during the milk-feeding stage, resulting from reduced access to feeding locations, on development of feeding behavior in pair-housed calves. The first hypothesis of this study was that calves would be able to compensate for competition for access to feeding locations for milk and solid feed. Specifically, it was predicted that, over time, calves in competitively fed pens would adapt their milk feeding patterns and social feeding behavior, including feeding synchrony and competitive interactions, to allow similar milk intake and growth compared with calves fed noncompetitively. Additionally, it was predicted that calves provided solid feed competitively would have similar feeding time and intake to calves fed noncompetitively. The second hypothesis of this study was that feeding behavior developed before weaning in response to a competitive feeding environment would persist postweaning and influence the ability of the calf to cope with competitive challenges. It was predicted that, postweaning, calves previously raised in competitively fed pens would have reduced feeding synchrony and be more competitive for access to feed. When subjected to competitive challenge, through restricting access to feed buckets, it was predicted that calves previously raised in competitively fed pens would adjust feeding patterns to maintain intake more effectively than calves raised in a less-competitive environment.

MATERIALS AND METHODS

Animals and Housing

Twenty male Holstein calves were used in this study. Calves were purchased and transported to the University of Guelph Kemptville Campus Dairy Education and Research Centre (Kemptville, ON, Canada) where they were managed according to the standard operating procedures of the research facility, in accordance with guidelines set by the Canadian Council on Animal Care (CCAC, 2009) and as approved by the University of Guelph Animal Care Committee (AUP #1913). All calves received colostrum and arrived at the research facility within 24 h of birth. Calves were randomly paired with calves of the same age and enrolled immediately in the study; thus, for each pair of calves, the first day of the study corresponded to d 2 of life. The study was conducted from May to August 2012, with all calves enrolled within the first 5 d of May.

Pairs of calves were housed together in pens (2.4 × 1.8 m; width × depth). Pen walls were solid on 3 sides (1.3 m in height) with a metal gate at the front. Openings in the gate at the front of the pen provided access to pails for water and feed (pails with 8-L capacity were used preweaning and pails with 20-L capacity were used postweaning). The interior of each pen was bedded with wood shavings, with bedding replaced weekly and fresh bedding added as needed. Calf pens were located under a 3-sided, roofed shelter, with the front of the pen facing the open side of the shelter to